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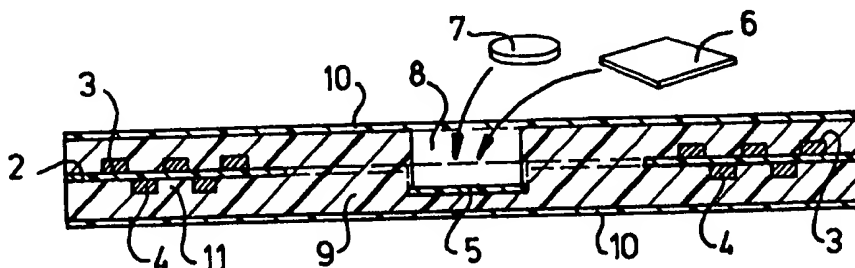
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**Published***With international search report.*

(54) Title: METHOD FOR THE PRODUCTION OF A SMART CARD, SMART CARD AND DEVICE FOR THE PRODUCTION THEREOF

## (57) Abstract

Method for the production of a coil containing card as well as a card. A support (2) is provided with a copper pattern (13, 4) on either side. This support is placed (12) in the cavity of an injection mould apparatus after which a plastic material is moulded around the support. The coil pattern is provided on the support either by etching of a copper layer on the support or by depositing copper material on the support. The relative position of the copper layer at opposite sides of the support is staggered relative to each other.



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Method for the production of a smart card, smart card  
and device for the production thereof

The present invention relates to a method according to the preamble of  
5 claim 1.

Smart cards are widely used. Identification and payment purposes may be  
mentioned.

Such a similar smart card can be connected to the surroundings by means  
of a magnetic strip or contacts.

10 Because such a manner of transferring data is relatively vulnerable, in  
particular if the card becomes damaged or is moved over magnets and the  
like, the aim is for contact-free transfer of information.

This can be realised by transmission (and reception). To this end, it is  
necessary for the card to be provided with a coil.

15 In the prior art numerous problems have been encountered with the  
production of such a coil. The requirement is always that the end product  
must comply with, inter alia, ISO/IEC Standard 10536. Compliance with this  
standard gives rise, in particular, to problems with regard to thickness.  
The intention is to provide a coil with optimum capacity. On the other  
20 hand, the crosstalk must be minimum. It is also desirable that mass  
production is possible, which implies that the manual tuning of coils must  
be avoided as far as possible.

From EP-0 671 705-A2 a method for producing a card and a card are known  
wherein a coil is arranged on one side of a support.

25 It is indicated that the coil can comprise a number of windings and such  
a coil is adhered to the support by gluing. According to another embodiment  
a coil is realized by having a single pattern of copper material on the  
support.

For many applications the properties of a coil, being a single pattern  
30 of copper material on a support, are insufficient. Because of that in the  
art a proposal of a coil having a number of windings and placed on the card  
is used. Such a card is not able to meet the requirements set to  
resistance against flexing. If such a card is bended several times the coil  
is disengaged from the support and/or the coil itself changes its  
35 properties.

The invention aims to provide a card with a coil having such properties  
that is suitable for functioning with frequencies generally accepted for a  
reading cards mentioned above, i.e. without contact.

This aim is achieved by a method as described above having the  
40 characterizing features of claim 1. Only by electro galvanic provision of a

copper pattern on both sides of support on the one hand sufficient capacity of the coil can be guaranteed whilst on the other hand sufficient resistance against bending is obtained. Electro galvanic provision comprises both electro galvanic deposition as well as etching.

- 5 According to a preferred embodiment of the invention the copper strips on one side of the support constituting the coil are never opposite to the copper strips constituting the spoil on the other side of support, i.e. are staggered. With this arrangement it has been found advantageous to choose the gap between two conductors of a coil to be greater than the thickness  
10 of the electrically conducting strip of a coil. The relevant conducting strip can then be placed in said gap on the opposite side of the support. Crosstalk is restricted as far as possible by this means.

Through the use of an electro galvanic technique for the provision of the copper pattern corresponding with the coils it can be guaranteed that  
15 opposed layers of the copper are exactly positioned relative to each other. Also during flexing this staggered arrangement of the opposed coils remains substantially unchanged which makes the card usable under all conditions.

- Because the adhesion of the material used to carry out the subsequent injection moulding and the support will not always be optimum, it is  
20 proposed to take a number of measures in order to provide for optimum accommodation by the support on which the coil is arranged and, where appropriate, a further section on which a printed circuit is arranged. To this end, a part of the support which does not contain the coil and/or printed circuit sections described above can be removed so that the plastic  
25 provides for enclosure from both sides.

Furthermore, it is possible to make openings or recesses in the support in the vicinity of the periphery of the card, that is to say at the limits of the coil, through which openings plastic is able to travel during injection moulding.

- 30 For series production it is important that a number of supports are placed simultaneously in an injection mould and are processed simultaneously in said mould to produce a number of cards.

When placing in the injection mould, it is important that the support with coils is placed accurately in a centred position. Centring pins can be  
35 present for this purpose. In order to fill the cavities which said centring pins leave behind, it is proposed to move said centring pins away during injection, that is to say after adequate solidification of the plastic material which surrounds the support. This has no further effect whatsoever

on the position of the support. Because post-injection is not always simple to realise, it is proposed to construct the mould in such a way that the mould surfaces can be moved even further towards one another after moving away the pins, that is to say that the volume of the mould cavity can be reduced. This reduction in volume must be such that the space previously taken up by the pins is now completely charged with plastic.

If, in the case of the embodiment described above, part of the support is provided with a printed circuit, and the term printed circuit must be understood as any pattern arranged or applied in any way, it has been found to be advantageous to move said part to one side of the mould cavity during injection moulding. This is preferably effected by means of a pin which remains present in the mould cavity during injection moulding and pin bears against the support in said location on the bottom of the mould cavity, specifically such that no plastic is able to form between the support and the base, by means of a spring system. When the size of the mould cavity is reduced, said pin will continue to bear against the support by means of the spring system. A cavity of relatively large depth forms in the finished card as a result, which cavity can be used for subsequent installation of an integrated circuit or other electronic component.

After fitting such a component, the card can be provided with a further finishing layer. This can be effected by placing the card in the injection mould again and, if appropriate, also by laminating. This finishing layer can be provided with conventional printing, relief patterns and the like. The card can also be provided with conventional magnetic strips and/or contacts.

The invention also relates to a card which is produced using the method described above. As already indicated, the support preferably consists of an aramide material of relatively small thickness. The copper layer used is preferably relatively thick in order to obtain optimum characteristics of the coil. In this context it is proposed to use values of between 40 and 100  $\mu\text{m}$  and preferably 70  $\mu\text{m}$  for the thickness of the copper layer. This is in contrast to the prior art, where values of 35  $\mu\text{m}$  are used. The copper layer can be attached to the aramide material by any method known from the prior art, such as by gluing.

The invention also relates to the moulding consisting of a support provided with a coil applied to one or both sides.

The invention also relates to an injection mould which, as has been described above, has a mould cavity of variable volume. This can be

achieved by constructing the lateral edge of at least one of the mould halves in the form of a movable ring. After the initial injection, the ring, which has been moved outwards, as a result of which an enlarged mould cavity is produced, is moved inwards, as a result of which a smaller mould cavity is produced. A ring of this type can be arranged at one or two sides of the separating surface of the mould.

The invention will be explained in more detail below with reference to illustrative embodiments shown in the drawing. In the drawing:

Fig. 1 shows a perspective and partially exposed view of the card according to the invention;

Fig. 2 shows a top view of a flat sheet consisting of four supports provided with coils;

Fig. 3 shows a cross-section of the card according to Fig. 1;

Figs 4 a-c show different stages of a method for applying a coil to the support;

Fig. 5 shows the mould for the production of the card according to the previous figures in a first closed position;

Fig. 6 shows the mould according to Fig. 5 in a second closed position; and

Fig. 7 shows the mould according to Figs 5,6 in a third closed position.

In Fig. 1 the card according to the invention is indicated in its entirety by 1. Cards of this type are used for identification purposes, payments and the like. As can be seen from the cross-section in Fig. 3, this card consists of a central support 2. This central support preferably consists of an aramide material which has a thickness of less than 60 micrometres and more particularly has a thickness of 50 micrometres.

A pattern consisting of copper material has been applied to this support, as can be seen from Fig. 2, which pattern forms the coil 3 on that side of the support 2 which is at the top in Fig. 3. Furthermore, a corresponding coil 4 is arranged on the underside of the support 2. The windings consist of pure copper material with a thickness of between 35  $\mu\text{m}$  and 100  $\mu\text{m}$  and preferably of 70  $\mu\text{m}$ . A gap 11 is present between the windings of the coil. This gap is greater than the width of the strip of the coil located on the other side of the support 2. That is to say, the construction is such that copper is never located opposite copper on either side of the support 2. By way of example, it can be mentioned that the width of the copper track is 0.6 mm and the centre-to-centre distance of the copper track is 1.8 mm. That is to say, there is a gap of 0.3 mm

between an upper track 3 and lower track 4. This gap is preferably between 0.01 and 0.5 mm.

A pattern of this type can be produced by any means known from the prior art, such as by punching, etching and the like.

5 One possibility is indicated in Figs 4a-c. In these figures, a copper layer 15 is stuck, for example by gluing, to support 2, as is shown in Fig. 4a. With the aid of a knife 16 or the like, an impression is made in the layer 15 (Fig. 4b), which results in separation of the copper, as a result of which gap 11 is formed, as can be seen from Fig. 4c.

10 Returning to Figs 1-3, it can be seen that the support is provided with a lip 5 in the middle of the length thereof, on which lip 5 a printed circuit, which is not shown in more detail, is applied. This assembly consisting of copper strips can be applied at the same time as the coils 3 and 4. As can be seen from Fig. 3, lip 5 is located in the vicinity of the  
15 underside of the card, so that a cavity 8 of appreciable depth is formed. As is indicated by arrows, components 6 and 7, which are an integrated circuit and a battery, can be arranged in this cavity 8. These components 6 and 7 can be connected in the conventional manner to the copper strips on lip 5. It is also possible to apply these components before the injection  
20 moulding and then to injection-mould around these.

As a result of the arrangement of lip 5 in the middle of the card, flexure of the card during use will give rise to as little stress as possible on the components 6 and the join with the support or the copper strips arranged thereon, because said components are located on the neutral  
25 line.

A further covering 10 is arranged around the plastic 9 which is applied during injection moulding. This further covering 10 can be realised by lamination, but also by a further injection moulding operation using a plastic of relatively low melting point. The flat sheet consisting of four  
30 finished cards is then converted into four cards by punching.

In Fig. 2 the flat sheet consisting of support with copper strips is indicated by 13. It can be seen that there are a number of openings 14 between the various support sections, which subsequently form the cards. Furthermore, the centre of each support is provided with an opening 12. As  
35 a result of these measures, optimum adhesion of the other part of the support takes place because the latter is as it were enclosed during injection moulding around it.

Figs 5-7 show, by way of example, a mould for injection moulding around

the flat sheet 13 shown in Fig. 2. As can be seen immediately, said flat sheet 13 has been drawn to a different scale than that in Fig. 2 and the various dimensions are likewise not drawn to scale in order to make the construction clearer.

5 Mould 20 consists of an upper mould 21 and a lower mould 22. Rings 23 and 24 are present, which rings can be pushed outwards with the aid of fluid-filled lines 27 arranged in grooves 30 in the vicinity of the base 28 of the two moulds. With this construction, relatively large force can be exerted on the rings 23 and 24. In addition to flat sheet 13, centring pins 10 25, which hold said flat sheet precisely in the correct position, are located in the mould cavity 29. Furthermore, a pusher pin 26 is present, which presses lip 5 downwards to close to, and in particular against, the base 28 of lower mould 22.

Plastic is injected in the position shown in Fig. 5.

15 Pins 25 are withdrawn, as can be seen from Fig. 6, before complete hardening, but after complete positioning, of flat sheet 13. As a result, free spaces 17 are formed in the plastic material which has just been injected. In order to fill the spaces, the pressure is removed from lines 27, as a result of which there is no longer any resistance offered to the 20 closing pressure of the mould halves, and the rings 23 and 24 move inwards, as is shown in Fig. 7. As a result the volume of the mould cavity is reduced in such a way that precisely the gaps 17 are filled. Pusher pin 26 remains in the mould cavity during this operation. The centring pins 25 are now employed as ejector pins by moving them again. After removal of the 25 flat sheet which has just been formed, cavity 8 forms as a result of the presence of pusher pin 26, as is shown in Fig. 3.

Further processing can then take place.

It must be understood that in various stages of the method described here the mouldings can be stored and handled in the form of rolls. This 30 makes particularly simple processing in different locations possible. The length of said rolls is unlimited in practice and the width can be between 10 and 90 cm. The various dimensions depend, in particular, on the size of the injection mould.

A value of 0.56 mm can be mentioned as an example of the thickness of 35 the support provided with the coils 3 and 4. The total thickness of the card, including the application of a finishing layer, can be between 80 and 100  $\mu\text{m}$ , that is to say within the range of the ISO/IEC Standard 10536 described above.



Although the invention has been described above with reference to a preferred embodiment, it will immediately be understood on reading the description that numerous modifications can be made thereto, which will be obvious to a person skilled in the art.

- 5 The scope of protection of the present application is therefore also determined by the appended claims.

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## Claims

1. Method for the production of a coil-containing card, wherein a coil is arranged on a support, said coil extending in the plane of the support, wherein said support with coil is placed in the cavity of an injection mould and injection moulded on either side and is removed therefrom as a card, characterized in that, the coil is electro galvanically provided on both sides of the support by providing in a copper pattern corresponding to the shape of the coil on either side of the support.
2. Method according to claim 1, wherein the electro galvanic provision comprises etching of the support provided with a copper layer on both sides thereof.
3. Method according to one of the preceding claims, wherein a part of the support, not containing the coil, is removed before said support is introduced into the cavity of the injection mould.
4. Method according to one of the preceding claims, wherein the support is designed to comprise various cards, provided with at least an equal number of coils, wherein perforations are made in the support between the coils, which perforations are filled during injection moulding, and wherein the cards formed in this way are separated from one another after/during the removal of the support from the injection mould.
5. Method according to one of the preceding claims, wherein centring pins are used before the support is placed in the mould cavity, which centring pins are moved away during injection moulding of the support, after which the mould is closed further.
6. Method according to one of the preceding claims, wherein a printed circuit for an integrated circuit and/or other component, which printed circuit is connected to the coil, is accommodated in the support.
7. Method according to Claim 7, wherein that part of the support which contains the printed circuit is brought close to one of the sides of the mould cavity during injection moulding and wherein the part located opposite is provided with a recess, in which a component is arranged after injection moulding.
8. Method according to one of the preceding claims, wherein the card is provided with a finishing layer after injection moulding and after any arrangement of a component.
9. Card (1) comprising a coil (3, 4) which is applied to a support (2) and extends in the plane of the card around the periphery, wherein the

support consists of plastic material with a thickness of less than 60 micrometres and the coil consists of a copper layer with a thickness of between 40 and 100 micrometres, characterized in that, the support comprises a polyester or aramide material being provided on either side of  
5 a directly adjacent copper pattern corresponding with the coil, the support being covered on either side by a layer of plastic (9) and the coil windings on the one side being arranged in the gap (11) between the coil windings on the other side.

10 10. Card according to Claim 9, wherein the support is provided approximately in the middle of its longitudinal extension with a printed circuit connected to the coil, which printed circuit comprises an integrated circuit and/or other components.

11. Card according to Claim 10, wherein that part (5) of the support which comprises the printed circuit is moved with respect to the other part  
15 of the support and a component is arranged in the cavity (8) located above it.

12. Card according to one of Claims 9-11, wherein a finishing layer (10) is applied on the plastic layer.

13. Support (2) as moulding for a card (1) comprising a strip of aramide  
20 material having a thickness of less than 50 micrometres provided on either side with a strip of copper material which extends in the plane of the support and has been formed into a coil, wherein the coil windings on the one side of the support are arranged in the gap between coil windings on the other side of the support.

25 14. Injection mould (20) for moulding articles, comprising at least one centring pin (25) which is movable in the mould cavity (29) and can be moved out of said cavity during injection moulding, and comprising at least two mould halves, at least one movable ring (23, 24) forming the outer limit of the mould cavity being arranged at the separating surface of the  
30 two mould halves.

15. Injection mould according to Claim 14, wherein a groove (30), in which an expandable means (27) is placed, is provided in the base (28) of the mould cavity where the ring is arranged.

16. Injection mould according to Claim 14 or 15, wherein a ring is  
35 arranged on either side of the separating surface in both mould cavities.

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1/2

fig-1

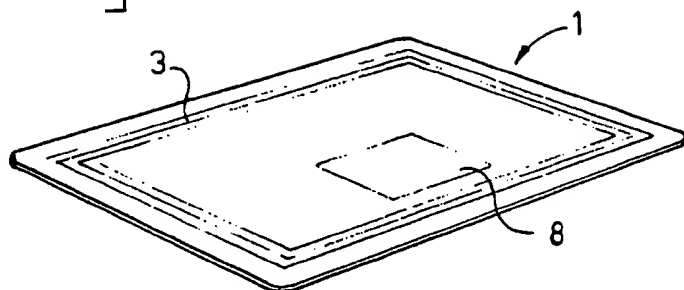


fig-2

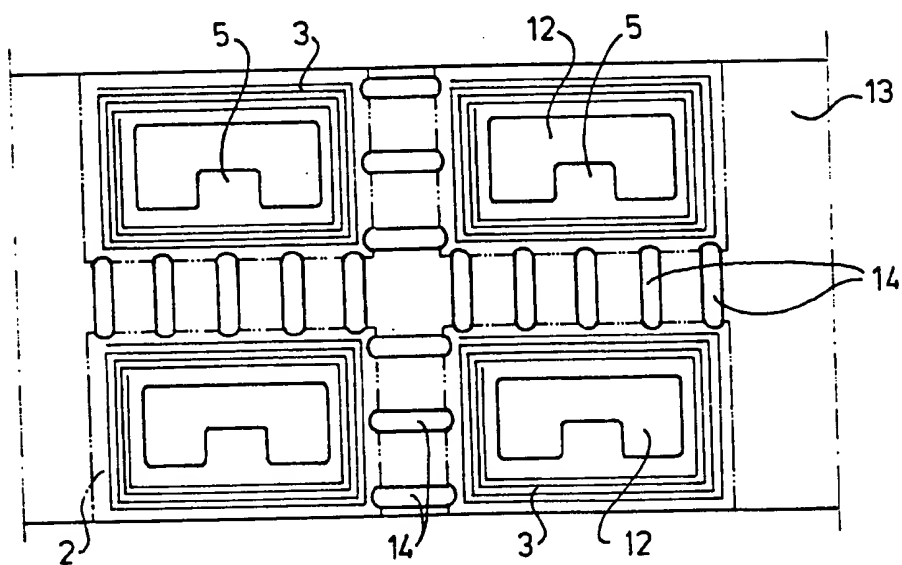
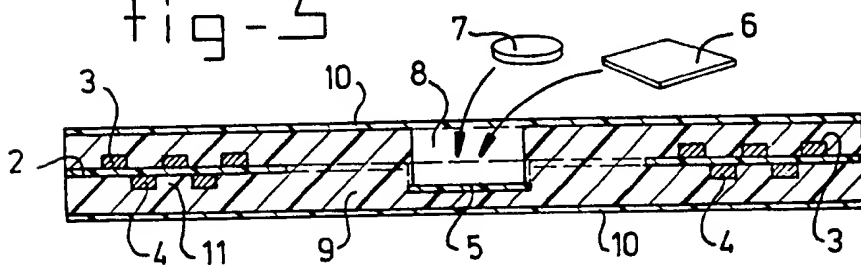


fig-3



2/2

fig-4a

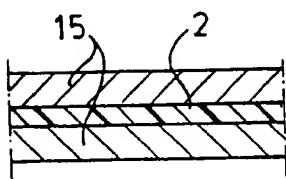


fig-4b

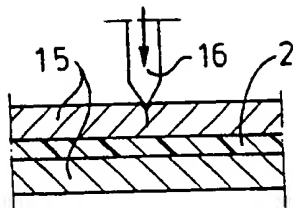


fig-4c

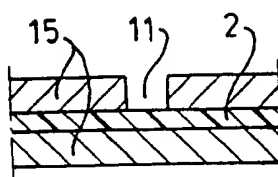


fig-5

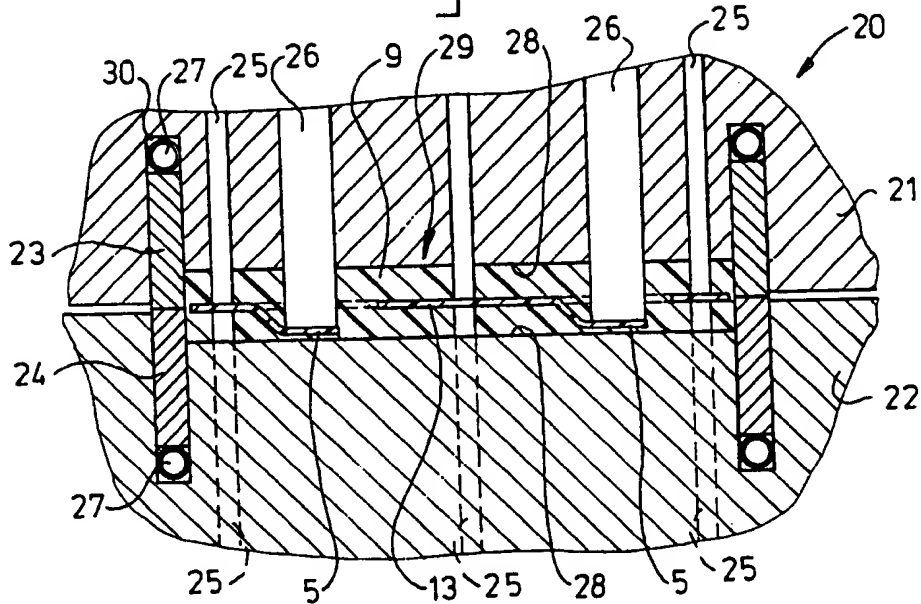


fig-6

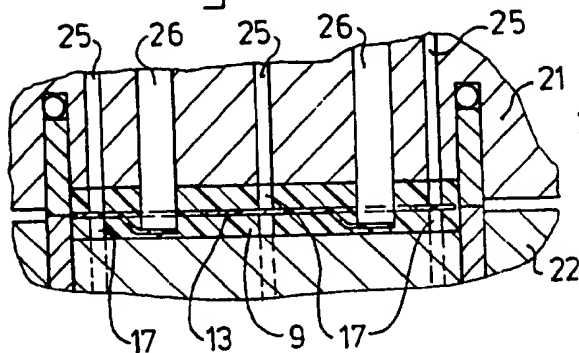
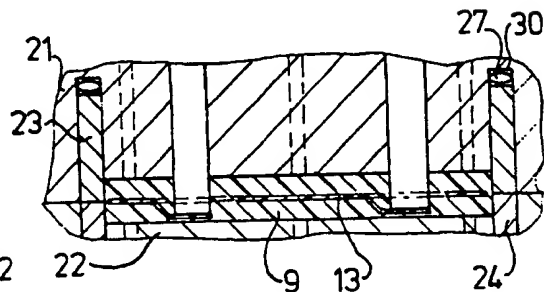


fig-7



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 97/00281

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 G06K19/077

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 768 620 A (PALOMAR TECHN CORP) 16 April 1997	1-3,6-8
A	see column 3, line 41 - column 4, line 18 see column 5, line 36 - column 7, line 57 see column 14, line 15 - line 18 ---	9,13
X	DE 195 11 300 A (TELEFUNKEN MICROELECTRON) 2 October 1996 see the whole document ---	1,2
A	WO 96 10803 A (SIEMENS AG ;MUNDIGL JOSEF (DE)) 11 April 1996 see the whole document -----	1,3

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

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Date of the actual completion of the international search

24 September 1997

Date of mailing of the international search report

02.01.98

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/NL 97/00281

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see annexed sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-3, 6-13

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims 1-3,6-13: Method for the production of a coil-containing card having a support, wherein coils are electro galvanically provided on both sides of the support and card having a support which comprises a polyester or a aramide material, wherein coil windings on one side of the support are arranged in the gap between coil windings on the other side, or support as moulding for such a card.
2. Claims 1.4: Method for the production of a coil-containing card having a support with perforations which are filled during injection moulding the cards being separated after/during removal of the support from the injection mould, a card or a support.
3. Claims 1,5 and 14-16: A method or injection mould for moulding articles wherein at least one centring pin is used which is moved away during moulding.



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 97/00281

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0768620 A	16-04-97	US 5574470 A CA 2185626 A	12-11-96 12-04-97
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